

Miniaturized Power Processing Unit Study: A Cubesat Electric Propulsion Technology Enabler

Completed Technology Project (2011 - 2012)



Project Introduction

This study evaluates High Voltage Power Processing Unit (PPU) technology and driving requirements necessary to enable the Microfluidic Electric Propulsion technology research and development by NASA and university partners. This study provides an overview of the state of the art PPU technology with recommendations for technology demonstration projects and missions for NASA to pursue.

This study investigates the technical requirements and potential solutions for miniaturized High Voltage Power Processing Units with the objective of enabling Microfluidic Electric Propulsion (MEP) thrusters for cubesats and large missions.

For the long term evolution of Electric Propulsion thrusters, Power Processing Units need to significantly reduce the mass, volume, and thermal properties. This will allow for usage of these thrusters from the micro down to pico-sized satellites, and enable long duration missions. Enabling the thruster technology will increase mission capabilities requiring orbital maneuvers including attitude control, spin, orbital inclination changes, de-orbiting, orbital transfers, swarm and formation flying.

The study focuses on the trade space to develop the Key Performance Requirements (KPRs) for the Power Processing Units and evaluates them against the current state of the art for technical feasibility. Topics investigated include:

- Mass
- Volume
- High Voltage parts evaluation
- Power Budget
- Output Power
- Number of control channels
- Modularity
- Scalability
- Operational modes
- Reliability
- Radiation Tolerance
- Power Efficiency
- Interfaces
- Cost
- Vendor Parts Availability

Anticipated Benefits

These missions will be proposed under the OCT's programs: - Franklin and Edison Technology Development Program - Game Changing Technology Division (OCT/GCT) NASA Broad Agency Announcement (BAA) Unique and



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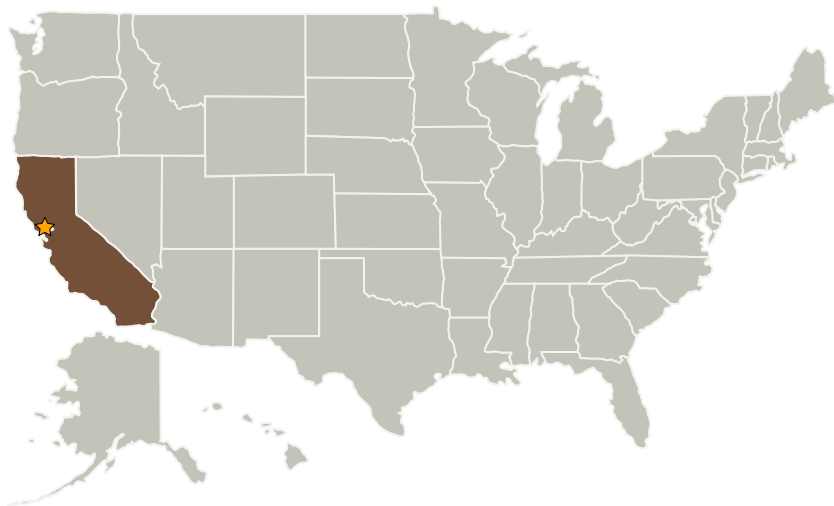
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Innovative Space Technology NNN11ZUA001K - Crosscutting Capability Demonstrations (OCT/CCD) NASA Broad Agency Announcement (BAA) Technology Demonstration Missions (TDM) program NNM11ZDA001K

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Ames Research Center(ARC)	Lead Organization	NASA Center	Moffett Field, California

Primary U.S. Work Locations

California

Stories

1676 Approval #17536
(<https://techport.nasa.gov/file/8740>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Ames Research Center (ARC)

Responsible Program:

Center Innovation Fund: ARC CIF

Project Management

Program Director:

Michael R Lapointe

Program Manager:

Harry Partridge

Project Manager:

Shakib M Ghassemieh

Principal Investigator:

Shakib M Ghassemieh

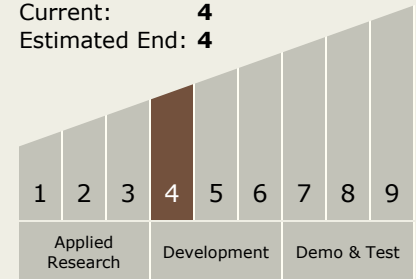
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Technology Maturity (TRL)

Start: **4**
Current: **4**
Estimated End: **4**



Technology Areas

Primary:

- TX03 Aerospace Power and Energy Storage
 - └ TX03.3 Power Management and Distribution
 - └ TX03.3.3 Electrical Power Conversion and Regulation